

3.1

Outline principles that define the cognitive level of analysis and explain how these principles may be demonstrated in research

Principle 1: Human beings are information processors and mental processes guide behaviour.

People are active information processors. They perceive and interpret what is going on around them. This is often based on what they already know. There is a relationship between people's mental representation and the way people perceive and think about the world.

Principle 1 demonstrated in:

Schema theory defines cognitive schemas as mental representations of knowledge. Mental representations (schemas) are stored in categories (concepts) in memory. These schemas provide guidelines for interpretation of incoming information when people try to make sense of the world. Schemas influence cognition in that schemas create expectations about what will happen in specific situations (e.g. what a "teacher" is like or what to expect when you go to a rock concert). Schema theory can, to a large extent, explain reconstructive memory and stereotyping.

Darley and Gross (1983) performed an experiment in which they showed participants videos of a girl playing in a poor environment, then in a wealthy environment. Then they saw a video of the girl in what could be an intelligence test. When the participants were asked to judge the future of the girl they all said that the "poor" girl would do worse than the "wealthy" girl. The study demonstrated how human beings actively process information based on a few salient details to form an overall impression that may not necessarily be correct.

Principle 3: Cognitive processes are influenced by social and cultural factors.

Research has shown that cognitive processes such as perception, memory, and thinking are influenced by sociocultural factors.

Bartlett (1932) introduced the concept of "cultural schema" in memory research. He suggested that schemas influence memory in that they lead to distortion or "reconstructive memory". Other researchers suggest that the environment in which people live leads to specific cultural and social demands that influence the way they process information.

DiMaggio (1997) suggests that schemas are (1) representations of knowledge (e.g. stereotypes and social roles) and (2) mechanisms that simplify cognition in the form of "cognitive shortcuts" that are shaped by culture. Schematic cognition is shaped and biased by culture (e.g. culturally based stereotypes).

Principle 2: The mind can be studied scientifically.

Cognitive researchers use a number of scientific methods to study the mind (e.g. laboratory experiments, neuroimaging, case studies, interviews, and archival research). The most used research method was, for a long time, the laboratory experiment, because it was considered to be the most scientific.

Principle 2 demonstrated in:

Loftus and Palmer (1974) performed an experiment to test reconstructive memory in relation to eyewitness testimony. The aim was to see whether misleading questions could distort memory. Participants saw a picture of a car crash and were asked to estimate the speed of the car based on questions such as "How fast was the car going when it smashed/hit/bumped into the other car?" Words such as "smashed" elicited higher speed estimations. Because the experimental method was used it was possible to establish a cause-effect relationship between the use of specific words and estimation of speed. Experimental research on memory has been criticized for lacking ecological validity.

Corkin et al. (1999) used MRI scans to observe the exact damage to H.M.'s brain. H.M. suffered from amnesia due to a brain operation where the hippocampus and adjacent areas had been removed to eliminate his epilepsy. The scans confirmed damage to these areas. Although a small part of the hippocampus had been spared it was not enough to support storage of new explicit memories.

Principle 3 demonstrated in:

Bartlett (1932) suggested that memory is guided by schemas and that culture can influence schemas. Previous knowledge determines the way people interpret incoming information and memory (memory distortion). He asked British participants to read an unfamiliar Native American story and reproduce it. The participants changed details of the story to fit with their own cultural schemas.

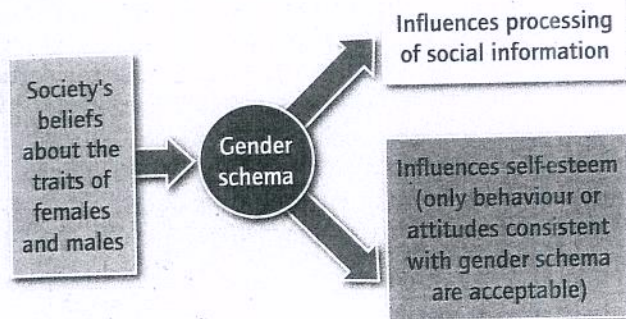
Cole and Scribner (1974) investigated how memory strategies were influenced by culture. The study asked children from a rural area in Liberia and children from the USA to memorize items from four different categories: utensils, clothes, tools, and vegetables. Children from the US improved performance after practice but the Liberian children did not unless they had attended school. Learning memory strategies, like "chunking", appears to be dependent on schooling and the illiterate children in the study did not use these strategies. The researchers concluded that the way cognitive psychologists study memory processes does not always reflect the way people learn to remember in real life.

3.2

Evaluate schema theory

- A cognitive schema can be defined as a mental representation of knowledge stored in the brain. A schema can be seen as a network of knowledge, beliefs, and expectations about particular aspects of the world.

- Schema processing is to a large extent automatic, i.e. processed with little attention. It involves information from two sources: Input from the sensory system (bottom-up processes) and information stored in memory (top-down processes), which is used to interpret the incoming information (pattern recognition, interpretation).



Bartlett (1932) suggests that schemas are active recognition devices representing an effort after meaning. Schemas help people make sense of the world, make predictions about it and what to expect, and provide guidance on how to behave.

DiMaggio (1997) suggests that schemas are (1) representations of knowledge (e.g. stereotypes and social roles) and (2) mechanisms that simplify cognition in the form of "cognitive shortcuts". Schematic cognition is shaped and biased by culture (e.g. in culturally based stereotypes). Gender schemas are examples of cognitive schemas shaped by sociocultural ideas about what is appropriate for men and women (i.e. norms).

Darley and Gross (1983) carried out a laboratory experiment on schema processing in the social world.

- In this laboratory experiment, the participants saw two videos of a girl. In video 1 a girl was playing in a poor environment; in video 2 a girl was playing in a rich environment. Then they saw a video of the girl in what could be an intelligence test.
- When the participants were asked to judge the future of the girls they all said that the "rich" girl would do well and the "poor" girl would do less well.
- The study demonstrates that participants probably used pre-stored schemas of what it means to be poor and rich and interpreted the ambiguous information accordingly. Participants processed information based on a few salient details to form an overall impression that may not necessarily be correct.

Possible ways in which schemas affect memory

- People tend to remember the meaning (gist) of something, not the actual wording.
- People use stored knowledge to make sense of incoming information. If the information is unclear or incomplete, they fill in the blanks or interpret using their schemas. This is called "reconstructive memory" and results in distortion.
- People tend to ignore information that is not in line with their schemas (aschematic information). This may lead to bias in information processing (e.g. in stereotyping where people ignore information that is not in line with their schema).
- People tend to focus on information that is in line with their schemas (schematic information). This may result in "confirmation bias".

Bartlett (1932) "The War of the Ghosts"

Aim To investigate whether people's memory for a story is affected by previous knowledge (schemas) and the extent to which memory is reconstructive.

Procedure Bartlett asked British participants to hear a story and reproduce it after a short time and then repeatedly over a period of months or years (serial reproduction). The story was an unfamiliar Native American legend called "The War of the Ghosts".

Results The participants remembered the main idea of the story (the gist) but they changed unfamiliar elements to make sense of the story by using terms more familiar to their own cultural expectations. The story remained a coherent whole although it was changed. It became noticeably shorter for each reproduction. Bartlett concluded that remembering is an active process. Memories are not copies of experience but rather "reconstructions".

Evaluation

- The results of the study confirm schema theory (and reconstructive memory), but it was performed in a laboratory and can be criticized for lack of ecological validity.
- Participants did not receive standardized instructions and some of the memory distortions may be due to participants' guessing (demand characteristics).
- In spite of these methodological limitations, the study is one of the most important in the study of memory.

Bartlett, F. (1932) *Remembering: A study in Experimental and Social Psychology*. Cambridge: Cambridge University Press.

3 Cognitive level of analysis

Brewer and Treyens (1981) Experiment on memory of objects in a room

Aim To investigate whether people's memory for objects in a room (an office) is influenced by existing schemas about what to expect in an office.

Procedure

- Participants were 30 university students, who arrived individually to the laboratory and were asked to wait in an office containing objects (e.g. desk, typewriter, coffee-pot, calendar). There were also other objects that did not conform to the office schema (a skull, a piece of bark, a pair of pliers).
- After waiting for some time, participants were taken out of the office and asked to write down everything they could remember from the room.

Results

- Most participants recalled the schematic objects (e.g. desk, typewriter).

- Some participants reported things that would be expected in a typical office but were not present in this one (e.g. telephone, books).
- Many participants also recalled the skull (unexpected object). The very unusual object resulted in better recall than predicted by schema theory.

Evaluation

- The study confirms schema theory (and reconstructive memory), but it was a controlled laboratory experiment so there are issues of artificiality.
- The study used deception (participants were not told about the real purpose of the experiment) but they were debriefed afterwards and not harmed. The study could not have been made without deception so it was justified.
- There is sample bias. University students were used as participants so it may be difficult to generalize the results.

Brewer, W.F. and Treyens, J.C. (1981) "Role of schemata in memory for places", *Cognitive Psychology*, 13, pp. 207-30.

Strengths of schema theory

- Schema theory has proven extremely useful in explaining many cognitive processes (e.g. perception, memory, and reasoning).
- Schema theory can be used to explain the reconstructive nature of memory, for example in eye witness testimony, stereotyping, gender identity (gender schema) and cultural differences (cultural schemas).

Limitations of schema theory

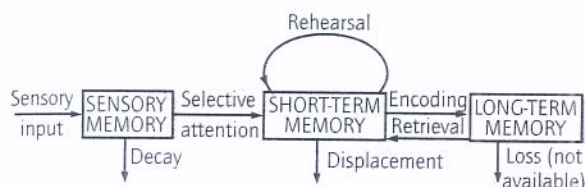
- Cohen (1993) argued that: the concept of schema is too vague to be useful and it is not clear how schemas are acquired in the first place.
- Schema theory may focus too much on the inaccuracies of memory but most of the time people remember accurately.

3.3

Evaluate two models or theories of one cognitive process with reference to research studies

Model 1: The multi-store model of memory (Atkinson and Shiffrin, 1968)

This model was one of the first to give an overview of the basic structure or architecture of memory and it was inspired by computer science. The model seems rather simplistic, but it did spark off the idea of humans as information processors and it has been one of the most influential models attempting to describe the memory system.



Atkinson and Shiffrin (1968)

- The multi-store model is based on the assumption that memory consists of a number of separate stores and that memory processes are sequential.
- The memory stores in the model are **structural components** that include **control processes** (e.g. attention, coding, and rehearsal). Rehearsal ensures the transfer of information from short-term memory (working memory) to long-term memory.
- **Sensory memory** registers sensory information and stores it for around 1–4 seconds. Information in the sensory memory is modality specific (i.e. related to different senses). Only a small amount of the sensory information will be transferred into the short-term memory (STM) store (depending on whether or not it is attended to).
- STM has limited capacity (around seven items) and limited duration (around 6–12 seconds). Information processed in STM is transferred into LTM if it is rehearsed. If not, it is lost.
- LTM is believed to be of indefinite duration and of potentially unlimited capacity.

Evidence of the multi-store model of memory: the serial position effect

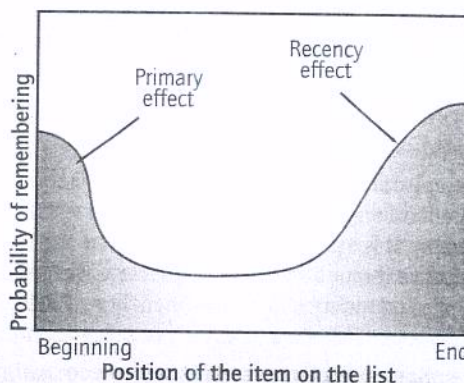
The serial position effect is believed to be linked to rehearsal, i.e. people repeat things in order to remember. The serial position effect suggests that people remember things better if they are either the first (primacy effect) or last (recency effect) item in a list of things to remember.

Glanzer and Cunitz (1966)

Aim To investigate recency effect in free recall (i.e. in any order).

Procedure This was a laboratory experiment where participants first heard a list of items and then immediately had to recall them in any order.

Results Participants recalled words from the beginning of the list (primacy effect) and the end of the list (the recency effect) best. The results showed a U-shaped curve. If participants were given a filler task just after hearing the last words, the primacy effect disappeared but the recency effect remained.



The recency effect could be due to the words still being active in STM (working memory). Rehearsal could be a factor in transfer of information into LTM.

Evaluation The study supports the idea of multiple stores (STM and LTM). This is a controlled laboratory study with highly controlled variables, but there is no random allocation of participants to experimental conditions so it is not a true experiment. There may be problems with ecological validity.

Evidence of the multi-store model of memory: case studies of individuals with amnesia due to brain damage

- Amnesia is caused by damage to the hippocampus and related networks involved in storage of new memories.
- MRI scans shows that H.M. had severe damage to the hippocampus which is critical in the storage of information into LTM.
- H.M. could store new procedural memories (implicit memory) but he was not able to store new explicit memories (semantic or episodic). This shows that the memory system contains different systems.

Strengths of the multi-store model of memory

- The model pioneered the new approach to memory where humans are seen as information processors.
- The model's conceptualization of memory as multi-stored is supported by research.
- It has been possible to make predictions based on the model and to design experiments.
- The overall model has been modified, for example by **Baddeley and Hitch (1974)** with their new version of short-term memory, the "working memory" model.

Limitations of the multi-store model of memory

- The model is very simplistic and it cannot account for how interaction between the different stores takes place (e.g. how information from LTM may indicate what is important and relevant to pay attention to in sensory memory).
- Research into the encoding of LTM has challenged the single-store version of LTM. It is now accepted that LTM contains several stores (e.g. semantic, episodic, procedural).

Model 2: The working memory model (Baddeley and Hitch, 1974)

- Baddeley and Hitch suggested the working memory model as an alternative to STM.
- This model challenged the view that STM is unitary and that information processing is passive.
- Working memory is seen as an active store used to hold and manipulate information. The model has been developed over the years to include findings from research (e.g. a fourth component, the episodic buffer, has been added).

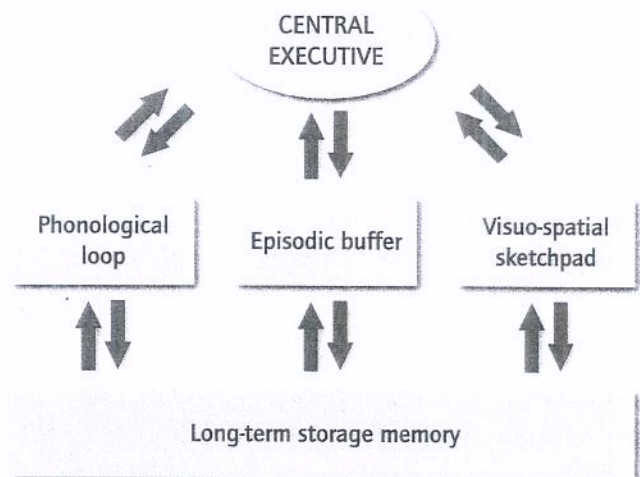
Working memory includes four separate components:

- **The central executive** A *controlling system* that monitors and coordinates the operations of the other components (slave systems). The central executive is *modality free* so it can process information in any sensory modality but it has limited capacity.
- **The episodic buffer** A limited-capacity temporary storage system or *interface* between the other systems in working memory. It is assumed to be controlled by the central executive through *conscious awareness*. The episodic buffer handles information in various modalities. The episodic buffer resembles the concept of episodic memory.
- **The phonological loop** handles *verbal and auditory information*. It is divided into two components:

- 1 **The articulatory control system:** the "inner voice".

- 2 **The phonological store:** the "inner ear". This can hold speech-based material active in a phonological form. It is assumed that a memory trace can only last from 1.5 to 2 seconds if it is not refreshed by the articulatory control system.

- **The visuo-spatial sketchpad:** the "inner eye". This handles visual and spatial information from either sensory memory (visual information) or from LTM (images).



Evidence of the working model of memory

- There is evidence of working memory in the so-called dual tasks experiments. The model assumes that there is a division of tasks between the different slave systems according to modality.
- If two tasks are done simultaneously (e.g. in dual tasks experiments or in multi-tasking) it is possible to perform well if separate systems are used. If concurrent tasks use the same system, it will affect performance negatively.
- **Baddeley and Hitch (1974)** asked participants to answer increasingly difficult questions about simple letter combinations that were shown at the same time. Reaction time increased as the questions became more difficult. The participants were then asked to do an articulatory suppression task (e.g. repeating "the" all the time, repeating numbers from 1 to 6, or repeating random numbers) while they answered the question. There was no

who was asked to repeat "the" or to repeat numbers from 1 to 6. The group who was asked to repeat random numbers had the worst performance. This was interpreted as overload problems for the central executive.

- **Quinn and McConnel (1996)** asked participants to learn a list of words by using either imagery or rehearsal. The task was performed on its own or in the presence of a concurrent visual noise (changing patterns of dots) or a concurrent verbal noise (speech in a foreign language). The results showed that learning words by imagery was not affected by a concurrent verbal task but it was disturbed by a concurrent visual task. The opposite was found in the rehearsal condition. This indicates that imagery processing uses the visuo-spatial sketchpad whereas verbal processing uses the phonological loop. If two tasks used the same component, performance deteriorated. The study thus lends support to different modality-specific slave systems and the idea of limited processing capacity.

Strengths of working memory

- The model has been useful in understanding which parts of the memory system may be linked to underlying problems in reading and mathematical skills.
- The model focuses on the processes of integrating information, rather than on the isolation of the sub-systems. This provides a much better basis for understanding the more complex aspects of executive control in working memory.

Limitations of working memory

- The major criticism of the first models of working memory was the unclear role of the central executive. This has been dealt with by including the episodic buffer in the revised model.
- The model has been criticized for its emphasis on structure rather than processing.

Compare and contrast the two models

	Multi-store model	Working memory model
Comparison (similarities)	<ul style="list-style-type: none">■ Provides possible architecture of the memory system (several stores)■ STM temporary storage, limited capacity and duration	<ul style="list-style-type: none">■ Provides possible architecture of the memory system (several stores)■ STM temporary storage, limited capacity and duration
Contrast (differences)	<ul style="list-style-type: none">■ Focus on the entire memory system■ Simplistic model of STM – not much focus on interaction between stores.■ STM temporary storage and gateway to LTM■ No specifications of content of STM	<ul style="list-style-type: none">■ Focus primarily on STM■ Much more complex idea of STM suggesting possible interactions between the stores, and especially modality-based functions of short-term memory (visuo-spatial sketchpad and phonological loop). The addition of a governing system (central executive) is a strength, although how it works is not yet well documented.
Evaluation	<ul style="list-style-type: none">■ STM and LTM are more complex than the model assumes.■ There is not enough focus on the interaction between the stores (e.g. how information from LTM is used to deal with chunking in STM).■ Rehearsal is not enough to explain transfer of information to LTM. The model cannot explain why memory strategies and elaborate rehearsal is efficient.	<ul style="list-style-type: none">■ Provides a better explanation of storage and processing than the multi-store model in that it can be applied to understanding, reading and mental calculations.■ Early versions of the model are vague on the role of the central executive, but later development of the model suggests that central executive guides attention via two systems (automatic and supervisory attentional system).■ The model is broadly accepted and considered important for understanding not only memory processes, but also cognitive processes such as thinking and problem solving (functional approach).

3.4

Explain how biological factors may affect one cognitive process

Damage to the hippocampus and amnesia

Scoville and Milner (1957) The case study of H.M.

- Scoville and Milner (1957) described the case of H.M. who fell off his bicycle when he was 7 years old, injuring his head. He began to have epileptic seizures when he was 10. By the age of 27 the epileptic attacks prevented him from living a normal life.
- Scoville performed an experimental surgery on H.M.'s brain to stop the seizures. The seizures stopped but H.M. suffered from amnesia for the rest of his life.
- The case study of H.M. provides information on how particular brain areas and networks are involved in memory processing. This helped scientists to formulate new theories about memory functioning.

H.M.'s memory

- H.M. could no longer store new memories (anterograde amnesia). Most of his memories from before the operation remained intact (partial retrograde amnesia).
- He could not transfer new semantic and episodic memories (explicit memories) into LTM.
- He could form new long-term procedural memories (implicit memories).
- He was able to carry on normal conversations (i.e. had some capacity for working memory) but he would forget what the conversation was about immediately.

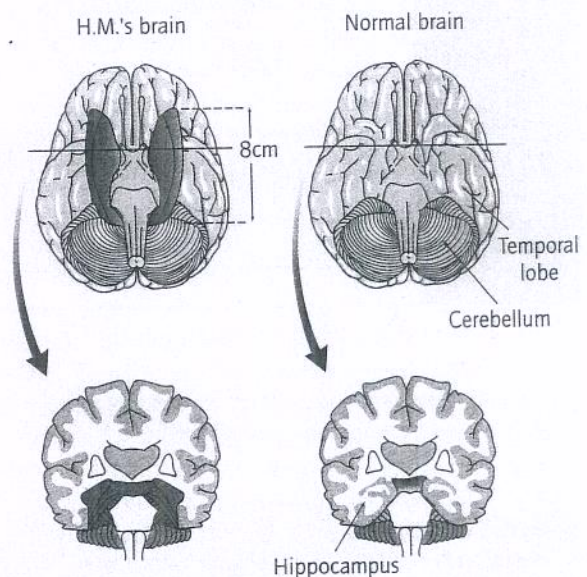
What can be learned about the relationship between the brain and memory from the case study of H.M.?

- The memory systems in the brain constitute a highly specialized and complex system.
- The hippocampus play a critical role in converting memories of experiences from STM to LTM (the permanent store).
- H.M. was able to retain some memories for events that happened long before his surgery. This indicates that the medial temporal region with the hippocampus is not the site of permanent storage in itself. It rather seems to play a role in how memories are organized and then stored elsewhere in the brain.
- The medial temporal region with the hippocampus is important for forming, organizing, consolidating, and retrieving memory. Cortical areas are important for long-term storage of knowledge and how to use this knowledge in everyday situations.
- The fact that H.M. and other people with amnesia have deficits in some types of memories but not in others is taken as evidence that the brain has multiple memory systems that are supported by distinct brain regions.

Explanation of the relationship between H.M.'s brain damage and his memory deficits

Corkin (1997) used MRI scans and analysed the extent of the damage to H.M.'s brain to find out. The scans showed that:

- Parts of the temporal lobes including the hippocampus and related structures on both sides were missing. This part of the brain's memory system plays a critical role in transforming short-term memories into long-term memories.
- These areas are involved in specific neurotransmitter pathways in memory (e.g. acetylcholine is believed to play an important role in learning and episodic memories).



High levels of cortisol and memory deficits

Cortisol is a stress hormone secreted by the adrenal glands in response to physiological or psychological stress. During long-term stress too much cortisol is released and this may affect not only immune functioning, but also memory processes. Chronic over-secretion of cortisol may hinder the brain in forming new memories or accessing already existing memories.

Sapolsky (1968) demonstrated that prolonged stress can damage the neurons in the hippocampus but this can be reversed if normal levels of cortisol are restored. Long-term stress could cause irreversible damage.

Lupien et al. (1998) followed a group of elderly people for five years to study the role of cortisol on memory. They found that cortisol secretion was too high in about 30% of the elderly population. Those who were exposed to excessive cortisol secretion for five years showed memory impairment and atrophy (shrinking) of the hippocampus. They also found that memory impairment can be reversed if the damage had not progressed to "a point of no return".

Lupien et al. (2002) Experiment on cortisol level and memory

Aim The experiment was a follow-up with two groups of the elderly people from the five-year study. The aim of the experiment was to see whether it was possible to reverse memory problems with a drug.

Procedure

- Participants were divided into two groups: group 1 had a moderate level of cortisol at baseline, and group 2 had a high level of cortisol and signs of impaired memory at baseline.
- Both groups were first given a drug preventing secretion of cortisol (metyrapone). Then they had to do a memory test. After this, both groups were given another drug (hydrocortisone) to restore their level of cortisol to previous levels. Results were compared with levels in a placebo group.

Results The results showed that participants with a moderate level of cortisol who were given metyrapone had no problem restoring normal memory function. Participants who, from the start, had a high level of cortisol had no memory improvement. Hydrocortisone caused even greater memory loss.

Exam Tip

The learning outcome "explain" requires you to show how biological factors influence a cognitive process. You are supposed to know two biological factors. You could also use acetylcholine and explain how this biological factor influences memory processes (see more on this in unit 2.3).

3.5

Discuss how social or cultural factors affect one cognitive process

Cultural and methodological considerations in cross-cultural research on memory

- **Wang and Ross (2007)** Culture is both a *system* (values, schemas, models, artifacts) and a *process* (rituals, daily routines, and practices). Culture affects why people remember, how they remember, when they remember, what they remember and whether they find it necessary to remember at all.
- When researchers conduct cross-cultural memory research with participants from Western and non-Western cultures they often use tasks developed in psychology laboratories, such as free recall of lists of unrelated words. In such tasks, the people from Western cultures generally do better. This could be because such tasks are meaningless to non-Western people.

Cultural and social demands determine memory

- **Bartlett (1932)** claims that cultural and social demands can explain the extraordinary ability of Swazi herdsmen to recall individual characteristics of their cattle. The Swazi culture revolves around the possession and care of cattle and it is important for people to recognize their animals.
- **Misty and Rogoff (1994)** argue that culture and memory are enmeshed skills. Remembering is an activity, which is determined by the demands of the social and cultural context in which it takes place. Remembering may be a means of achieving an important social or cultural goal. For example, the Itamul elders in New Guinea have an extraordinary memory for lines of descent and history. This kind of knowledge is important to them because it can help resolve property disputes with conflicting clans.

Cole and Scribner (1974) Cross-cultural study of memory

Aim To investigate free recall in two different cultures, the USA and the Kpelle people in Liberia.

Procedure For the test in Liberia, the researchers used objects that would be familiar to the Liberian children. The list of words belonged to four distinct categories. American children were given free recall tests matching their culture. The researchers presented the words to the participants and asked them to remember as many of them as possible in any order (free recall). In the second part of the experiment, the researchers presented the same objects in a meaningful way as part of a story.

Results

- In the free recall test, the non-schooled participants hardly improved their performance after the age of 9 or 10. They remembered around 10 items on the first trial, and around two more after 15 practice trials. Liberian school children performed as school children of the same age did in the USA. They also used similar memory strategies.

- In the second part of the experiment, the non-schooled Liberian participants recalled objects well because they grouped them according to the roles they played in the story.
- School children in Liberia and the USA used chunking and recalled items according to categories. The non-schooled Liberian children did not use the categorical structure of the list to help them remember. This indicates possible cultural differences in cognitive processes such as categorization and memory.

Evaluation The extent to which it is culture or schooling (or both) that influenced memory and categorization in the study is not entirely clear. The experimental method was used and it can help to establish cause-effect relationship, but since the independent variable was culture (or schooling) it may be difficult to say anything definite about cause-effect relationships.

More research on culture and memory

Rogoff and Waddel (1982) found that Mayan children did better in a memory task if they were given one that was meaningful to them in local terms. The researchers constructed a miniature model of a Mayan village, which resembled the children's own village. The researcher then selected 20 miniature objects from a set of 80 (e.g. animals, furniture, people) and placed them in the model. Then the objects were taken out of the model and replaced among the 60 objects. After a few minutes, the experimenter asked the children to reconstruct the scene they had been shown. Under these conditions, the Mayan children did slightly better than the children from the USA.

The study shows that the content and context of a memory task are important and that useful memory strategies are learned in a sociocultural context.

Culture and memory summing up

- The implication of many cross-cultural memory studies is that, although the ability to remember is universal (hardware), specific forms of remembering (software) are not universal but rather context-bound.
- A methodological problem exists as most memory research is conducted in cultures with formal schooling systems. This makes it difficult to generalize findings to cultures with no formal schooling.

3.6

Evaluate the extent to which a cognitive process is reliable

- Memory is not a "tape recorder" or an exact replica of what happened, but rather a "reconstruction". Schema theory can explain why this happens. Reconstructive memory indicates that memory is only reliable to some extent.
- Cognitive researchers have found that memories are not fixed and can be lost, changed, or even created. Memories may also be scrambled in the process of retrieving them and they can be manipulated (Loftus, 2003). Eyewitness testimony has been found to be incorrect on numerous occasions where DNA has revealed that the wrong person was convicted. All this indicates that memory is not always reliable.
- We tend to remember the overall meaning (gist) of something and we reconstruct the information to some extent when we retrieve it.
- Sometimes memory is distorted for personal reasons, for example to enhance our own importance (self-serving bias).

Reasons for inaccuracies in memory could be:

- Memory is reconstructive (e.g. Bartlett, 1932) and information processing is schema driven (see unit 3.2).
- Memories are constructed after the fact and they are susceptible to post-event information and manipulations (e.g. Loftus and Palmer, 1974).
- There is no relationship between people's belief that their memory is accurate and the memory's accuracy (e.g. Neisser and Harsch, 1992). (See more on "flashbulb memories" in unit 3.9).

Bartlett (1932) The theory of reconstructive memory

This theory assumes that humans are active information processors who construct memories as they try to make sense of what happens based on what they already know. Schemas stored in LTM help people make sense of the world around them. Bartlett called this "effort after meaning". People do not simply remember information because the prestored schemas determine what to remember. He suggested that the reconstructive nature of memory based on schema processing could explain memory distortions (see Bartlett's study in unit 3.2).

Strengths of the theory of reconstructive memory

- The model can explain memory distortions well.
- It is supported by many empirical studies and laboratory experiments (e.g. Loftus and Palmer, 1974).

Limitations of the theory of reconstructive memory

- The model may focus too much on the inaccuracy of memory.
- Schema processing is not fully understood.

Loftus and Palmer (1974) Reconstruction of automobile destruction (the first experiment)

Aim To investigate whether the use of leading questions would affect recall in a situation where participants were asked to estimate speed. This is a situation that could happen when people appear in court as eyewitness testimonies.

Procedure The student participants saw videos of traffic accidents and had to answer questions about the accident. In experiment 1, the participants were asked to estimate speed of the cars based on a critical question: "About how fast were the cars going when they smashed into each other?" "Smashed" was replaced by words such as hit, collided, bumped or contacted in other conditions (experiment 2 is not included here).

Results The mean estimates of speed were highest in the "smashed" condition (40.8 mph) and lowest in the "contacted" group (31.8 mph). The researchers calculated a statistical test and found that their results were significant at $p \leq 0.005$. The results indicate that memory is not reliable and that memory can be manipulated by using specific words. The critical word in the question consistently affected the participants' answer to the question. One explanation could be that the use of different words influenced participants' mental representation

of the accident, i.e. the verb "smashed" activates a cognitive schema of a severe accident and therefore speed estimates increase. It is not the actual details of the accident that are remembered but rather what is in line with a cognitive schema of a severe accident. This is in line with Bartlett's suggestion of reconstructive memory. It could also be that participants simply had difficulties estimating speed. This cannot be ruled out.

Evaluation The experiment was conducted in a laboratory. There may be a problem of ecological validity. Neisser has criticized laboratory experiments on memory for being too artificial. The fact that the experiment used students as participants has also been criticized because students are not representative of a general population. The films shown in the experiment were made for teaching purposes and therefore the participants' experience was not the same as if it had been a real accident. The experiment was rigorously controlled so it was possible to establish a cause-effect relationship between the independent variable (the critical words) and the dependent variable (estimation of speed).

Loftus, E.F. and Palmer, J.C. (1974) "Reconstruction of automobile destruction: An example of the Interaction between language and memory", *Journal of Verbal Learning and Verbal Behavior* 13, 584-589.

Riniolo et al. (2003) on accuracy of eye witness testimony in a real life situation – the plunge of Titanic.

Aim To investigate the reliability of memory for a central detail of eye witnesses to the Titanic's final plunge (i.e. whether the Titanic sank intact or broke in two before it went down). It was believed at the time that the ship went down intact.

Procedure The researchers used archival data, i.e. transcripts from two hearings in 1912, one in the USA and one in the UK. The researchers identified 20 cases (N = 20) from the total amount of 91 survivors in the hearings who had explicitly addressed the state of the ship during its final plunge.

Results 75% of the eyewitnesses in this study, i.e. a total of 15, said that Titanic was breaking apart during sinking and 25% said Titanic was intact while it was going down. The majority of the 20 selected eyewitness testimonies in this study said that the ship broke in two before the plunge so *central traits* of the event were recalled accurately, although the memory was formed during traumatic conditions (high emotional arousal). After the hearings it was concluded that the Titanic sank intact and this "myth" has

been repeated in the literature until the discovery of the wreck. Reasons for this could be that it was believed that the Titanic could not sink and the general belief that memory is impaired when witnessing a traumatic event.

Evaluation The case study only investigated memory for one central trait. The eyewitnesses used in this archival study were part of a subgroup and they are not representative of all the eyewitnesses. There might have been bias in the interrogations towards confirmation of a pre-existing belief of the intact ship. It is not possible to determine if post-event information could have influenced the testimony. The sample was small and it was not possible to interview the eyewitnesses for clarification because they were all dead at that time. It was not possible to measure perceived trauma either. In spite of these methodological limitations, this case study contributes to our knowledge about the accuracy of eyewitness testimony from people who witness a traumatic event in real life.

Riniolo, T.C., Koledin, M., Drakulic, G.M., and Payne, R.A. (2003), *Journal of General Psychology*, 130 (1): 89-95.

Exam Tip You may also use Bartlett (1932) from unit 3.2. You need a minimum of two studies in an essay so you could choose an experimental study and one of the studies dealing with memory in real life.

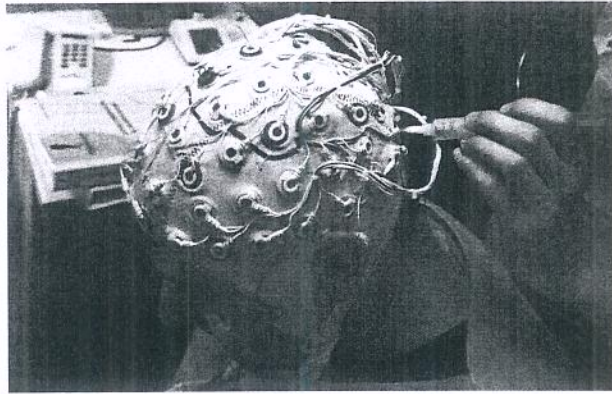
3.7 Discuss the use of technology in investigating cognitive processes

- The use of advanced technology in research on cognitive processes provides insight into the complexity of the activity of the brain's neuronal network in cognitive processes that underpin behaviour.
- Cognition always involves neuronal activity in the brain. Modern technology, e.g. EEG (electroencephalography) and fMRI (functional magnetic resonance imaging), can be used to study cognitive processes while they are taking place (e.g. in traditional cognitive research on memory but also in research on neuroeconomics and neuromarketing).
- Neuroimaging, such as fMRI, can register changes in blood flow in the active brain (oxygen and glucose consumption in the brain). The researchers can then make a map of areas in the brain related to specific cognitive processes.
- Neuroimaging has revealed that cognitive processes are mediated by a network of distributed interacting brain regions and each area makes specific contributions.

EEG and MEG

EEG (Electroencephalography) refers to the recording of the brain's electrical signals, i.e. the firing of the many neurons in the cortex of the brain. Electrodes are placed on the scalp to register what parts of the brain are active and in what ways. EEG can be used to record electrical activity for research purposes (e.g. which areas are active when a child listens to its mother's voice).

MEG (magnetoencephalography) is a technique used to record magnetic fields produced by the natural electrical activity in the brain.



Palva et al. (2010) Working memory

Aim To investigate the interaction of neuronal networks in the cerebral cortex in relation to visual working memory.

Procedure Data from EEG and MEG was used to identify patterns of interaction between the neurons (neuronal synchrony) in the cerebral cortex during visual tasks.

Results The results showed synchronization of neuronal activity in different brain areas related to the maintenance and contents of working memory. Specific networks interacted (e.g. different areas of the brain's frontal and parietal lobes played a central role in coordinating attention and action in working memory). Handling and maintaining sensory information about visual stimuli showed activity in networks in the occipital lobe.

Evaluation The findings support Baddeley's model of working memory (e.g. the central executive could be linked to the activity

in the frontal and parietal lobes). The activity in the networks in the occipital lobe could be linked to the visuo-spatial sketchpad (see more on the working memory model in unit 3.3). The neuroimaging technologies used were important to detect specific brain areas involved in cognitive processing. This could not be done otherwise.



Phonological loop –
temporal lobes of the
left hemisphere



Visuo-spatial memory –
right hemisphere



Central executive –
dorsolateral prefrontal
cortex

MRI

MRI (magnetic resonance imaging) produces three-dimensional images of brain structures. It is used to detect structural changes in the brain in cases of brain damage or illness.

- H.M. suffered from amnesia and was not able to form new explicit memories. This case study demonstrated that explicit memory processes are dependent on the hippocampus and adjacent cortical structures, but the exact damage to H.M.'s brain was not known before researchers could use brain imaging.

- **Corkin et al. (1997)** used MRI to study H.M.'s lesion in the first attempt to use modern technology to study his brain.
- The results of the MRI scan confirmed a relationship between damage to the medial temporal lobes (including the hippocampus) and H.M.'s amnesia. Although a tiny part of the hippocampus remained it was not enough to support normal memory function.

Strengths of using modern technology

- It provides the opportunity to see inside the working brain as it operates by mapping active brain areas. It is also possible to see synchronization between various brain areas involved in cognitive processes.
- It is useful in diagnosing brain disease or damage that causes problems in cognitive functioning (for example memory problems in Alzheimer's).

Limitations of using modern technology

- Scanning takes place in a highly artificial environment and some scanners are extremely noisy. This affects ecological validity.
- Scanner studies can map brain areas involved in various cognitive processes but it is not yet possible to say anything definite about what these pictures actually mean.

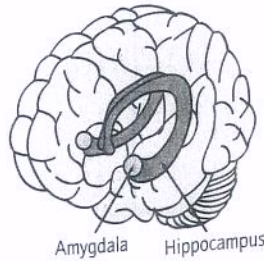
3.8

To what extent do cognitive and biological factors interact in emotion?

- **Damasio (2000)** *Emotions* are physiological signals as a reaction to external stimuli, and *feelings* (conscious interpretation of the emotion) arise when the brain interprets the stimuli.
- The emotion "fear" is a useful survival mechanism as it allows animals (and humans) to react quickly to any possible sign of danger by starting the "fight or flight" reaction. In humans, cognitive factors such as *appraisal* may help to modulate physiological and psychological reactions to stimuli.
- Emotional arousal is a form of stress that activates the stress hormones adrenaline and cortisol. This is a useful survival mechanism. Memory of a fearful experience is stored in the cortex (explicit memory) and the emotional memory of the experience is stored via the amygdala (implicit memory). Normally humans can control irrational fear reactions but not always, and in some cases fear may be elicited without conscious control as in panic attacks.
- Anxiety, phobia, panic disorders, and PTSD in humans indicate a malfunction in the brain's ability to control fear reactions. Humans with damage to the amygdala do not experience fear in dangerous situations and this may endanger survival.

Brain, memory, and emotion

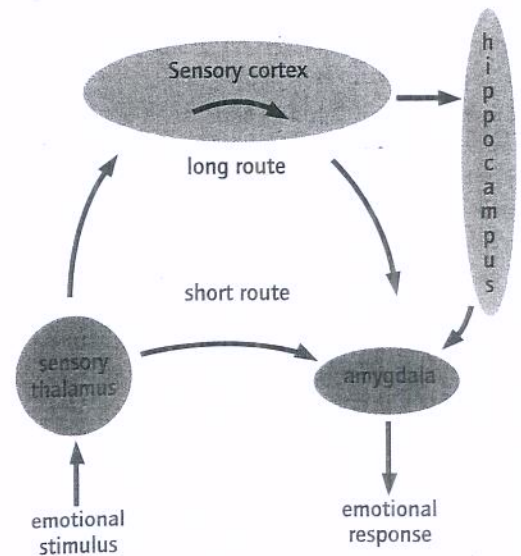
- Investigations into the role of emotion on explicit memory have focused primarily on the interaction of the **amygdala** (specialized for the processing of emotion) and the **hippocampus** (necessary for semantic and episodic memory).
- **Phelps (2004)** suggests that in emotional situations the amygdala can modulate memory encoding and storage of explicit memories (hippocampal dependent memories) so that emotional events receive priority.



LeDoux's theory of the emotional brain (1999)

Humans' emotional reactions are flexible due to evolution. Learning to detect and respond to danger is important for survival (e.g. an instant response is needed in dangerous situations). Humans have also evolved "emotional feeling", i.e. a conscious experience of the emotion which helps to evaluate the level of danger before a response.

LeDoux's two pathways of emotions in the brain:



1. **The short route** The amygdala reacts immediately to sensory input and activates response systems (e.g. the physiological stress response "fight or flight"). This is very useful in the case of immediate danger where a quick reaction can make the difference between life and death.
2. **The long route** The sensory input goes via the sensory cortex to the hippocampus. This route involves evaluation of the stimulus and consideration of an appropriate response. This could link to the concept "cognitive appraisal" (Lazarus, 1975).

Easterbrook (1959) Cue utilization theory (central traits and peripheral traits)

- The theory predicts that in situations with high levels of emotional arousal, people will tend to pay more attention to and encode details of the emotion arousing stimulus

(central details) and not pay attention to details that are not central to the emotional arousal (peripheral details).

- See Riniolo et al. (2003) on memory for central traits in a traumatic event (The Titanic's final plunge) in unit 3.6.

Sarason (1975) Appraisal theory

According to appraisal theory, cognitive factors can modulate stress responses, i.e. the physiological and psychological reactions involved in the experience.

Appraisal can be seen as an *evaluation* of a situation, including evaluation of one's psychological and material resources to cope with the stressful event.

Sarason et al. (1964) Experimental manipulation of emotions through cognitive appraisal

To investigate the extent to which manipulation of cognitive appraisal could influence emotional experience.

Procedure

In this laboratory experiment participants saw anxiety-evoking films, (e.g. a film of an aboriginal initiation ceremony where adolescent boys were subjected to unpleasant genital cutting).

This film was shown with three different soundtracks intended to manipulate emotional reactions. The "trauma condition" had a soundtrack with emphasis on the mutilation and pain; the "intellectualization condition" had a soundtrack that gave an anthropological interpretation of the initiation ceremony; the "denial condition" showed the adolescents as being willing and happy in the ceremony.

During each viewing of the film various objective physiological measures were taken, such as heart rate and galvanic skin response.

Results The participants in the "trauma condition" showed much higher physiological measures of stress than the participants in the two other conditions. The results support the appraisal theory in that the manipulation of the participants' cognitive appraisal did have a significant impact on the physiological stress reactions. The participants in the "trauma condition" reacted more emotionally.

Evaluation This was a laboratory experiment with rigorous control so it may lack ecological validity, but research on the role of appraisal in real-life emotional events tends to find the same relationship as laboratory research.

The study could be a demonstration of how biological and cognitive factors interact in emotion and it illustrates LeDoux's theory of the two pathways in emotional processing.

Summary of the interaction of emotion and cognition

Cognitive and biological factors do, to a large extent, interact in emotion, but in complex ways that are not yet well known. Emotions may influence cognitive processes such as memory, and cognitive processes such as appraisal may influence emotions, but little is known about the exact workings of the physiological correlates of emotion.

The influence is often bidirectional and this has been explored within health and abnormal psychology.

- Neuroimaging investigations of emotion have identified areas in the prefrontal lobes associated with active reappraisal of the emotional importance of events (Ochsner and Gross, 2008). This indicates that it is possible to regulate negative emotions via appraisal.

3.9

Evaluate one theory of how emotion may affect one cognitive process

Brown and Kulik (1977) The theory of flashbulb memory (FM)

- Flashbulb memories are a type of episodic memory (explicit memory). It is assumed that they are highly resistant to forgetting, i.e. the details of the memory will remain intact and accurate because of the emotional arousal at the moment of encoding. This is controversial.
- FM can be defined as a highly accurate and exceptionally vivid memory of the moment a person first hears about a shocking event.
- The "flashbulb" indicates that the event will be registered like a photograph, i.e. it will be accurate in detail.
- Brown and Kulik suggested that FM is often rehearsed because it is important or emotionally salient to the individual and this makes the memory more accessible and vividly remembered over time.

According to the theory, there are six important features about FM that people remember in detail:

- place (i.e. where they were when the incident happened)
- ongoing activity (i.e. what they were doing)
- informant (i.e. how they learned about the incident)
- own affect (i.e. how they felt – their emotional status or affect)
- other affect (i.e. how other people felt)
- aftermath (i.e. importance of the event – the consequences).

Brown and Kulik (1977) Research on FM

Aim To investigate whether shocking events are recalled more vividly and accurately than other events.

Procedure Questionnaires asked 80 participants to recall circumstances where they had learned of shocking events

Results

- The participants had vivid memories of where they were, what they did, and what they felt when they first heard about a shocking public event such as the assassination of John F. Kennedy.
- The participants also said they had flashbulb memories of shocking personal events such as the sudden death of a relative.
- The results indicated that FM is more likely for unexpected and personally relevant events. The researchers suggested 'the photographic model of flashbulb memory'.
- Brown and Kulik suggest that FM is caused by the physiological emotional arousal (e.g. activity in the amygdala).

Evaluation The reliance on retrospective data questions the reliability of this study. People tend to interpret an event from their current perspective. Research indicates that although an FM is emotionally vivid it is not necessarily accurate in regard to details. The photographic model of FM has been challenged.

Neisser (1982) is critical towards the idea of flashbulb memories, as certain memories are very vivid because they are rehearsed and discussed after the event.

Neisser and Harsch (1992) did a real life study on people's memory of the Challenger disaster. The first data were collected less than 24 hours after the event and the same participants were tested two and a half years later. Most participants did not remember anything correctly but were very confident that they did.

Neisser and Harsch (1992) Testing the FM theory

Aim To test the theory of flashbulb memory by investigating the extent to which memory for a shocking event (the Challenger disaster) would be accurate after a period of time

Procedure

- 106 students in an introductory psychology class were given a questionnaire and asked to write a description of how they had heard the news. They also had to answer seven questions related to where they were, what they were doing, etc., and what emotional feelings they experienced at the time of the event.
- Participants answered the questionnaires less than 24 hours after the disaster.
- Two and a half years later, 44 of the original students answered the questionnaire again. This time they were asked to rate how confident they were of the accuracy of their memory on a scale from 1 to 5. The participants were also asked if they had filled out a questionnaire of the subject before.
- Sometime after the last questionnaires, the researchers performed a semi-structured interview to test whether the participants could remember what they had written previously. Participants then saw their original reports from the first questionnaire.

its

Only 11 participants out of the 44 remembered that they had filled out the questionnaire before.

There were major discrepancies between the original questionnaire and the follow-up two and a half years later. The mean score of correctness of recall of the seven questions was 2.95 out of 7. For 11 participants the score was 0, and 22 scored 2 or less. The average level of confidence in accuracy for the questions was 4.17.

The results challenge the predictions of the FM theory and also question the reliability of memory in general. Participants were confident that they remembered the event correctly both times and they could not explain the discrepancies between the first and second accounts.

Evaluation

- The study was conducted in a natural environment and it has higher ecological validity than laboratory experiments on memory. The participants were psychology students who participated for course credits and they may not be representative.
- The degree of emotional arousal when witnessing a shocking public event may be different from experiencing a traumatic event in your own personal life, and the importance of the events may be very different. This could influence how well people remember a certain event.

Strengths of the FM theory	Limitations of the FM theory
<ul style="list-style-type: none">■ The theory can, to some extent, explain why very emotional memories are often more vividly remembered over time, but it cannot explain why these memories are often no more accurate than any other memory (except perhaps for some central details).■ The theory has generated many research studies and the theory has been modified. The idea that emotional events are better remembered than non-emotional events is supported, but modified with the idea that the event should have specific personal relevance.	<ul style="list-style-type: none">■ "Flashbulb" refers to the flashbulb used in photography, but the name may not be well-chosen as the photograph taken with a flashbulb preserves everything in the scene as it was at the time the picture was taken.■ An FM is a "reconstructed memory" where the emotional importance of the event may influence the way the memory is reconstructed - particularly if it is discussed with other people over time (confabulation) or if the memory does not have particular personal relevance.